ES116: Principles and Applications of Electrical Engineering

TurnAware: Advanced Safety System for Blind Turns

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***Abstract*— This report outlines the development and implementation of TurnAware Advanced Safety System for Blind Turns, which aims to address the safety risks posed by curved roads with limited visibility. The system's design, materials required, working principle, and anticipated benefits are discussed in detail.**

I. AIM

To develop a sensor-based alert technology, named TurnAware, to enhance road safety on dangerous curved roads. TurnAware aims to alert drivers of approaching vehicles from the opposite direction, mitigating the risk of accidents caused by blind turns. By leveraging advanced warning systems, TurnAware seeks to provide real-time alerts to drivers, enabling them to navigate curved roads safely and effectively, thus reducing the frequency of accidents on roads with limited visibility.

II. THEORY

A. Infrared (IR) sensors

Infrared (IR) sensors operate based on the principle of detecting infrared radiation emitted by objects in their vicinity. These sensors consist of an emitter and a receiver. The emitter emits infrared light, while the receiver detects the reflected or emitted infrared radiation. When an object is within the detection range of the IR sensor, it either reflects or emits infrared radiation. The receiver then captures this radiation and converts it into an electrical signal. The strength of the received signal is proportional to the distance and characteristics of the object.

For proximity sensing, the sensor measures the intensity of the reflected infrared radiation to determine the distance of the object from the sensor. In contrast, for object detection, the sensor analyses changes in the received signal to detect the presence or absence of an object within its detection range.

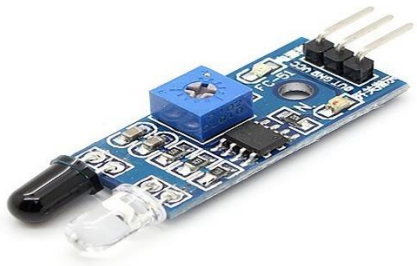

Fig. 1 IR sensors

B. Working Principle

The infrared (IR) sensors are strategically positioned along curved turns to detect vehicles approaching from opposite directions. When two vehicles are sensed within a specified range, signals are sent to the Arduino, triggering the warning system. The Arduino then sends the output signals to the LEDs according to the input it receives from the sensor. If the sensor detects an incoming vehicle, the LED light on the other side of the turn transitions to red, signaling danger. Upon clearance, one LED turns green, allowing one vehicle to pass safely, followed by the other LED turning green for the second vehicle, reducing the incidence of accidents.

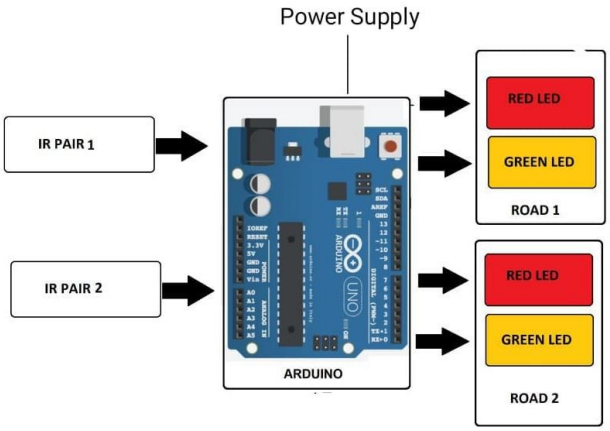

Fig 2. Block Diagram of Circuit

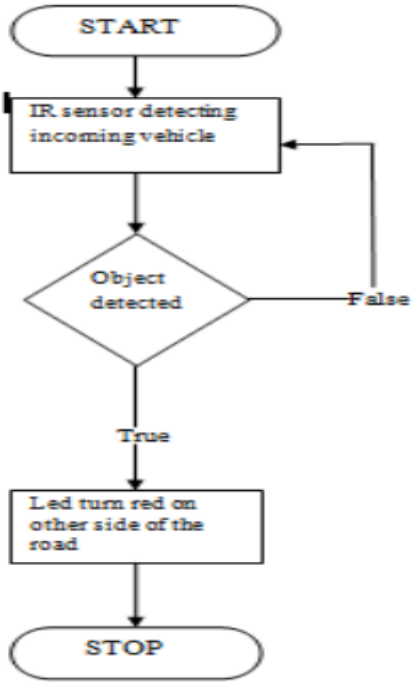

Fig 3. Flowchart of the system

III. MATERIALS REQUIRED

1. Arduino Uno Board
2. Two IR Sensors
3. LED's (Red Colour: 2, Green Colour: 2)
4. Four 330 Ω resistors
5. Jumping Wires
6. Insulation Tape
7. Breadboard
8. Power Supply

IV. PROCEDURE

Following steps were undertaken to achieve this project:

1. Connect the VCC pin of each sensor to the Arduino's 5V pin and the GND (ground) pin of each sensor to the Arduino's GND pin.
2. Connect the output pin of the IR sensors for Side 1 and Side 2 to digital pin 2 and 3 respectively.
3. Connect the anode (positive) of each LED to a current-limiting resistor of 330 Ω.
4. Connect the other end of the resistor to the following digital pins of Arduino for the respective LEDs:
   Red LED for Side 1: digital pin 4
   Green LED for Side 1: digital pin 5
   Red LED for Side 2: digital pin 6
   Green LED for Side 2: digital pin 7
5. Connect the cathode (negative) of each LED to the Arduino's GND pin.
6. Arduino was powered up from the supply of a laptop.

This Arduino code is designed to detect obstacles or motion and provide alerts accordingly:

```
#define IR_SENSOR_PIN_SIDE_1 2
#define IR_SENSOR_PIN_SIDE_2 3
#define LED_PIN_RED_SIDE_1 4
#define LED_PIN_GREEN_SIDE_1 5
#define LED_PIN_RED_SIDE_2 6
#define LED_PIN_GREEN_SIDE_2 7

void setup() {
  pinMode(IR_SENSOR_PIN_SIDE_1, INPUT);
  pinMode(IR_SENSOR_PIN_SIDE_2, INPUT);
  pinMode(LED_PIN_RED_SIDE_1, OUTPUT);
  pinMode(LED_PIN_GREEN_SIDE_1, OUTPUT);
  pinMode(LED_PIN_RED_SIDE_2, OUTPUT);
  pinMode(LED_PIN_GREEN_SIDE_2, OUTPUT);
  pinMode(BUZZER_PIN, OUTPUT);

  // Initially set green LEDs on both sides
  digitalWrite(LED_PIN_GREEN_SIDE_1, HIGH);
  digitalWrite(LED_PIN_GREEN_SIDE_2, HIGH);
}

void loop() {
  int obstacleDetectedSide1 =
digitalRead(IR_SENSOR_PIN_SIDE_1); // Read IR
sensor state for side 1
  int obstacleDetectedSide2 =
digitalRead(IR_SENSOR_PIN_SIDE_2); // Read IR
sensor state for side 2

  // Check if obstacle is detected on side 1
  if (obstacleDetectedSide1 == HIGH) {
    digitalWrite(LED_PIN_RED_SIDE_1, HIGH);
// Turn on red LED for side 1
    digitalWrite(LED_PIN_GREEN_SIDE_1, LOW);
// Turn off green LED for side 1
  } else {
    digitalWrite(LED_PIN_RED_SIDE_1, LOW);
// Turn off red LED for side 1
    digitalWrite(LED_PIN_GREEN_SIDE_1, HIGH);
// Turn on green LED for side 1
  }
```

```
  // Check if obstacle is detected on side 2
  if (obstacleDetectedSide2 == HIGH) {
    digitalWrite(LED_PIN_RED_SIDE_2, HIGH); //
Turn on red LED for side 2
    digitalWrite(LED_PIN_GREEN_SIDE_2, LOW); //
Turn off green LED for side 2
  } else {
    digitalWrite(LED_PIN_RED_SIDE_2, LOW); //
Turn off red LED for side 2
    digitalWrite(LED_PIN_GREEN_SIDE_2, HIGH);
// Turn on green LED for side 2
  }
}
```

V. RESULT

As a result, we successfully crafted the final model of TurnAware: Advanced Safety System for Blind Turns which can be used to enhance road safety on dangerous curved roads. Real-time warnings are provided to drivers, enabling them to navigate curved roads safely, thereby reducing the risk of accidents.

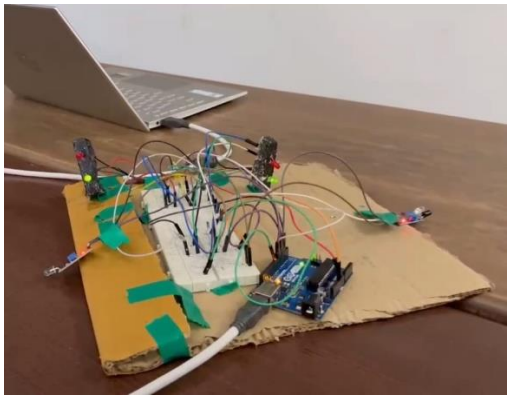

Fig. 4 When both side pathways are clear, green signals for safe passage.

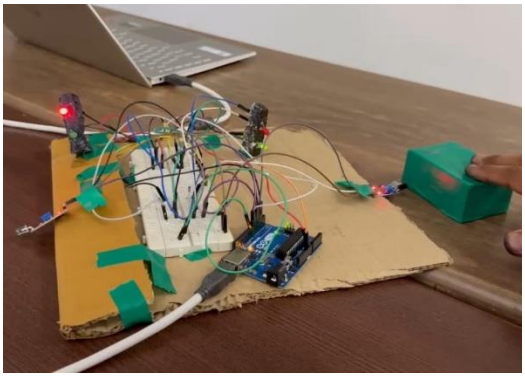

Fig. 5 When the sensor detects a vehicle on one side, the Red Signal prompts caution on other side.

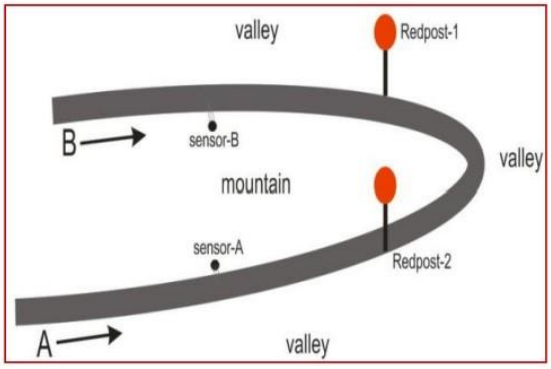

Fig. 6 Schematic diagram of Accident prevention system

VI. DISCUSSIONS

In our discussions over sensor selection for our project, we thoroughly assessed various options, including ultrasonic, laser, and infrared (IR) sensors. IR sensors emerged as the optimal choice due to their consistent performance in different conditions and minimal susceptibility to environmental factors. This decision ensures reliable vehicle detection on curved roads with limited visibility.

What distinguishes our project is its seamless integration into existing infrastructure. Placed at curved road corners, our system enhances safety by detecting vehicles, pedestrians, and obstacles in real-time. Unlike traditional safety measures like convex mirrors which are only useful during day, our solution operates day and night, offering superior functionality.

VII. ACKNOWLEDGMENT

We thank Professor Arup Lal Chakraborty for his valuable input and suggestions for our idea and the final project. We also extend our gratitude to our Teaching Assistant Mr. Abhinav for his continuous guidance.

VIII. REFERNCES

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[2] Nevon Projects, “Smart Road Safety and Vehicle Accident Prevention System for Mountain roads,” *Nevon Projects*, Jan. 22, 2020. https://nevonprojects.com/smart-road-safety-and-vehicle-accident-prevention-system-for-mountain-roads/